

# **Towards Business Intelligence Cost Accounting (Working Paper)**

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## **Abstract**

This paper provides an overview of the methods, concepts, and frameworks regarding the accounting of costs and performance for Business Intelligence (BI). Existing scientific work was screened and relevant contributions were then evaluated against the requirements for a cost and performance allocation as introduced in this paper. Due to the limited number of publications on the accounting of BI costs and performance, we extended our survey to include the Information Technology (IT) perspective in an effort to present some approaches and assess their applicability for BI purposes. As a result, we concluded that there is currently no holistic approach to BI cost accounting. There are, however, some approaches that could improve the accounting of single components within a BI architectural landscape.

*Keywords:* Business Intelligence, Controlling, Cost and Performance Allocation, Cost Accounting

## **1 Introduction**

Business intelligence (BI) is defined as an integrated, company-specific, IT-based global approach to operational decision support [10]. The principal purpose of BI is to use past experience to support the making of decisions [3].

The evaluation of either a company's entire BI investments or of individual BI artifacts is a known and nontrivial issue [8]. A BI artifact is described as the output of a BI organization in a general form. Alongside single activities such as *monitoring the data warehouse* or *user support*, a report could be described as a product-oriented BI service including multiple BI activities. Furthermore, a BI application consisting of few reports is defined by some BI services. A BI project is therefore understood as the implementation of one or many BI applications. Due to rising costs as well as a

more complex architecture [32], in addition to new technology and methods, BI requires justification to management, especially during difficult economic times [12] [21].

The amount of stored data is currently rising exponentially, not only in terms of consumer markets (e.g., social media) but also in companies. This development can be seen, for example, in the enhancements of ERP or CRM systems, or by new intelligently networked production processes which represent the fourth industrial revolution: *industry 4.0* [28]. These *new*, or rather machine, data generate competitive advantages [25] for those companies that are able to analyze and use these data in a target-oriented way. The resulting increase in data creates new informational demands [33] that must be met by a BI organization, for example. The ever-growing volume of information brings with it additional costs, and these costs must be charged fairly to those that bring them about. BI cost and performance accounting, then, takes on new significance when the required architecture for preparing the data is taken into consideration.

In addition to this perspective, today's enormous cost pressure is leading companies to look for new outsourcing possibilities [26]. The relevance of delivering BI as a service is becoming ever greater [30]. It is possible, then, for an in-house BI department to be outsourced [14]. On the one hand, to evaluate outsourcing possibilities, companies must know the costs of their BI artifact portfolio. In order to come closer to a financial evaluation of the BI cost driver, all costs must be carried together and structured so that they lead to a more exact allocation of BI artifacts in a fair way. On the other hand, the BI provider has an even greater reason to bill BI costs in a clear and adequate way, as this increases the sales potential of BI artifacts. In both cases it is important to ensure that the price of a BI artifact is calculated in a differentiated way, so that its implementation, operation, and any later reengineering are all taken into account. Seen from an in-house perspective, flat rates and fixed distribution keys make cost controlling and planning issues difficult, since, in the simplest of cases, they are estimated by the BI management with no regard for the BI architecture, organization, or resource consumption of each department [17]. With an appropriate cost accounting system, cost transparency will increase. It will also become possible to calculate both individual BI artifacts and entire BI projects so that the beneficiary can recover the costs. If they are charged with BI costs, beneficiaries within a company might also become sensitized to the economical use of BI. Furthermore, an improvement in cost controlling could bring about a more efficient and effective use of BI resource project planning. Aside from the possibility of allowing make-or-buy decisions or cost benchmarks to be made, the improved cost transparency comes one step closer to performing a profitability analysis.

In most cases, the total costs for a BI technology landscape in a company can be calculated [27]. However, in order to allocate costs in a fair way, the top level must be broken down so as to make the individual BI artifacts visible and to determine costs at the BI artifact level. In most previous studies over the past decade regarding the evaluation of information systems, the cost perspective was regarded as resolved. However, this is not always the case. The degree of complexity stems from predominantly fixed and indirect costs which therefore make a cost allocation necessary, demonstrating that many unresolved issues still remain [18] [31].

This situation makes it more difficult to realize a BI cost evaluation, which indeed must be distinguished from the traditional information technology (IT) perspective by its specific architecture and business domain.

The aim of this paper is to create an overview of possible BI cost accounting approaches that are pertinent and suitable. Our focus is on design-oriented approaches that, for example, are based on a

process model. As the number of publications addressing BI cost and performance accounting is limited, we extended our survey to include the IT perspective in an effort to present a variety of approaches and assess their applicability for BI purposes. After a short comparison of BI and IT, requirements for internal cost allocation are introduced so as to enable the evaluation of the presented approaches. This paper concludes with a future outlook on this topic.

## 2 Comparison of BI and IT

According to the definition in Section 1, BI is understood as a subarea of IT: On the one hand, it shares commonalities with IT, but on the other hand it differs significantly from all other areas of IT [20] and therefore must be differentiated in this paper.

This differentiation can be made by concentrating on the following characteristics: cost structure, business domain, technical and functional requirements, and architecture.

It goes without saying that the cost structure of both BI and IT is similar. Both areas have basically fixed costs for hardware, software, and personnel [11]. The difference lies in the fact that all BI artifacts are typically based on a common BI architecture. This leads to a huge pool of indirect costs for the BI software and hardware used. For example, an IT service such as a PC workplace or a specific departmental software application consists more of direct costs than indirect costs. This, then, makes it easier to allocate the service to a beneficiary. How could one determine the costs for a single report (reports being different from a development point of view, as a report's complexity and consumption of resources could increase by a single measure) or an analytic application (a cube for sales data) in a sensible way? Using a special BI cost accounting approach as detailed in this paper, this question could be answered.

Another area in which BI and IT differ is the business domain. While BI mainly provides information across organizational units within a company—and supports executives and management—IT concentrates on the company-wide availability of information technology for supporting the value-added process in the classic sense [4]. This means that BI must deal with various delivery systems and transform raw data into valuable data while keeping the organizational-wide requirements for supporting the decision-making process in mind.

As a result, the requirements in these areas are different. BI is affected by complicated interdependencies regarding technical and functional requirements which lead to a higher level of complexity. In most cases, heterogeneous departmental objectives must be merged due to a lack of standardized managerial activities; this situation is different when it comes to transaction systems hosted by IT departments [20].

Another point of differentiation can be found in the architecture. For example, IT is characterized by the provision of hardware (PC workplace) and standard or individual software to support the execution of operational activities within a company. BI differs from IT by its integrated nature. Consequently, within the process of creating BI artifacts, a plethora of tools is generally used. Operational data must be extracted from heterogeneous data sources and transformed and historicized. This data also must be made recipient-oriented in order to provide decision-making support across a level-oriented BI architecture. Cost accounting, therefore, becomes more complex, as corresponding resources are shared. A higher complexity in the BI development process is expected, due to dependencies and close links that may exist between parts of the operational systems. A uniform definition, then, is necessary for corporate data integration, including technical, as well as functional, aspects [5].

In sum, BI artifacts, due to both their underlying developmental and operational architecture and target audience, differ from classic IT artifacts and therefore must be treated differently.

With regard to these different ways of creating output, one thing becomes clear: Depending on the architecture, there is a different way of allocating or charging. From an IT perspective, this point in particular must be taken into consideration by existing cost accounting approaches and, therefore, must be examined carefully before adopting BI.

The fundamental requirements for a cost accounting system and internal cost allocation [2] [6] are presented below: A comparison is made between the IT and BI perspectives since, on the one hand, these requirements differ in their understanding and realization and, on the other hand, the differentiation between the two may enable a new approach to be developed with regard to BI accounting:

- Fair allocation of IT/BI artifacts: As compared to IT, BI has a shared infrastructure made up predominantly of fixed costs. Therefore, a fair allocation of BI is realized by taking into consideration the complexity of a BI artifact created over the layered BI architecture (exact monitoring is expensive, so a new “more economical” approach is required).
- Transparent and comprehensible pricing: For acceptance reasons, a beneficiary should be able to understand how an artifact’s price has been derived. Due to the complexity of BI, providing a description is a completely different activity than in the IT area. The price of a PC workplace or hosted software, for example, is calculated using the corresponding hardware or licensing costs. To calculate a price for a report, relevant costs within the BI architecture must be estimated. In this case, multiple components are shared by other BI artifacts.
- Understandable definitions of IT/BI activities for beneficiaries: A beneficiary should be able to understand which activities are included when buying an artifact. Activities obviously differ depending on the described areas (e.g., DWH development in BI and installation of a PC workplace in IT)
- Equal treatment of all beneficiaries: This requirement is especially difficult to realize in BI. For example, two apparently identical reports could be assigned the same fee. It would only take one different measure, however, to change the complexity of a report, thereby significantly increasing the use of resources. For equal treatment, then, a new fee would be required. The entire BI artifact portfolio is subject to this situation.
- Economically justifiable execution of internal cost allocation: To satisfy this requirement in terms of the complex topic of BI, an approach needs to be realizable without an excessive amount of effort.
- Compatibility with the cost and activity accounting system: Since IT/BI accounting costs fall under the controlling and cost and performance accounting area, an approach should be compatible with this field. Furthermore, considering the constantly changing BI environment, a potential approach should have a degree of flexibility and not be based on technology.

### **3 BI cost accounting concepts, methods, and frameworks**

A literature review of previous work in BI cost and performance accounting is now presented. The existing literature provides no concrete approaches to solving the BI cost accounting issue in an overall context. However, some useful work regarding subareas of BI and IT concepts are briefly

described below. We chose methods, concepts, and ideas from the academic literature as well from publications of IT/BI professionals or companies who deal with this topic and have pertinent approaches with which to improve BI cost accounting.

### **3.1 State of the art: Managing costs and performance of information technology (Hamel, Herz, Uebernickel, & Brenner, 2010)**

This paper presents an overview of relevant scientific work regarding the topic of IT cost and performance over the period from 2000 to 2010 [13]. Although the focus of this work is IT, this paper was the starting point for our review, as it covers established IT controlling literature and provides a synthesis of relevant articles from information systems journals.

In their work, Hamel et al. define a common understanding of IT controlling. In a general sense, IT controlling is used to ensure an effective and efficient usage of underlying IT resources. More specifically, those objects generated by the relationship between information processing, controlling, and leadership are controlled in terms of effectiveness and efficiency. Furthermore, objectives such as functionality, quality, and adherence to deadlines are also taken into consideration. IT controlling coordinates the management of IT resources within an organization while keeping a defined IT strategy in mind. It attempts to achieve greater transparency about information management and the use of IT for decision-making support. Given the range of methods used to examine the value of existing and future IT assets, IT controlling provides a value-oriented management of IT resources.

As BI costing is related to IT resource costing, the work of Hamel et al. will be given further consideration [17], [6], [7] and [9]. A particularly promising approach may be found in [17].

### **3.2 ITIL – Financial management for IT services (Cannon, Wheeldon, Lacy, & Hanna, 2011)**

This publication presents a collection of best practices for IT service management, and is otherwise known as the IT infrastructure library (ITIL) [1]. The financial management component for IT services is described as the process that manages the budgeting, accounting, and charging requirements of IT services. The goal is for an IT organization, which operates as a separate business unit, to carry out the accounting related to the costs they incur, and to create IT services for customers in an organization. The IT organization also aims to provide management with the opportunity to, for example, calculate business cases for proposed IT services. In addition to the topics of budgeting and pricing in this ITIL component, the focus of this section is on the accounting of IT services.

One basic element proposed by Cannon et al. is a cost model identifying expenditures and describing how costs relate to specific services and/or customers. This cost model is then used as a financial baseline from which to derive costs or pricing. A service provider, then, could define more than one cost model, depending on the organization and the individual objectives. One possible cost model is *cost by IT organization* which distinguishes between direct costs, such as salary, and indirect costs (shared costs), such as the network backbone as seen by IT. These costs are combined to arrive at the total cost of IT and are then simply allocated, for example by the number of users to relevant business units. This model can be expanded to the *cost by service* model which calculates the total costs per service. Here direct and indirect costs are assigned to specific IT services. The allocation of indirect costs is described as being difficult and potentially requiring the use of measurement tools to ensure fair allocation. With regard to allocation, the following methods are mentioned and only briefly defined: Activity-based costing, utilization-based allocation, agreed basis for allocation, and indirect cost rate. [1]

### Evaluation

ITIL proposes a framework for designing IT service management processes. It also covers a variety of aspects regarding the financial management of IT services. Using the cost models outlined above, an allocation of IT services is provided. Due to their general nature, these approaches do not begin to explain how to carry out BI allocation. Using the requirements from Section 2, the above-mentioned approaches can help to determine how best to carry out an allocation from the IT perspective.

### **3.3 ITIL based on BI**

ITIL can also be applied to BI. Consulting firms have tried to adapt ITIL when considering particular BI requirements. Here general reference processes are proposed for the creation of BI artifacts. In addition, subjects for data delivery management, data quality management, as well as data structure management are considered [29]. Furthermore, some ITIL processes have been adapted to BI by Gansor et al. [4], such as a process for metadata management. The question of how to charge BI costs and performance, however, remains unanswered.

### **3.4 Internal cost allocation for IT (Bertleff, 2001)**

Bertleff motivates how strategic controlling can be supported by IT cost allocation [16]. The main task of strategic controlling is to verify that the right things are done for the right customers. To support this issue in the IT context, a controller should know, for example, which activities give rise to which costs as well as which person is responsible. Furthermore, it must be determined whether the underlying IT department is working in an efficient and effective way. To increase the transparency of this situation, IT cost allocation should be introduced. The objectives of such cost allocation should be derived from the corporate strategy and must be clarified before implementation. Possible objectives could be an improvement of the transparency of IT costs and performance, or allocation according to the cost-by-cause principle. We maintain the importance of keeping the customer as the center focus and creating customer-oriented IT products that are accountable in an understandable way. Bertleff points out that allocation over technical factors such as CPU usage or storage I/O cannot be used due to the difficulty of understanding and planning the resource consumption for customers. Therefore, a cost model is presented which distinguishes between an external, more product-oriented view for the customer, and an internal view representing single IT activities. Forming an IT product based on individual IT activities is described as complex and is not further specified. The idea is to allocate single IT activities to a customer (such as costs for hardware, software licenses, or LAN costs) by means of a defined IT product (such as a PC workplace). For planning issues and better transparency, an IT product catalog, containing IT activities or pricing, for example, describes individual products.

### Evaluation

This paper takes an IT product-oriented view. With regard to the requirements in Section 2, Bertleff's work is to improve the process of forming understandable definitions of IT services, such as the concrete example of a classic PC workplace. The other requirements are only briefly discussed and therefore remain undefined. It is our view that for an approach to allocate BI costs and performance, it must take this approach into consideration and extend this view to include a BI-specific architecture.

### **3.5 Cost allocation for data warehouse competency centers (Klesse, 2008)**

This paper focuses on a method to carry out cost allocation for data warehouse competency centers (DWH CC) [11]. Products and services of the DWH CC, then, are modeled as so-called information

products. These special types of products are based on an information product model that Klesse introduces in this paper. The cost model and accounting factors can be adjusted to fit the cost allocation's objectives. In addition, various pricing models are available to realize, for example, a cost-covering pricing. This method follows the principle of identifying all DWH activities, assigning them to information products as well as describing them both in terms of quality and quantity. Cost-performance weighting is carried out from a quantity and quality perspective. For a modeled information product, platform and process services must be assigned in detail. A platform service refers, for example, to storage capacity or CPU usage for a single entity. A process service refers, for example, to the development of an entity or of information. Klesse goes on to further describe how to use this concept to carry out cost and performance accounting. Due to the fact that the resulting cost and performance accounting system is based on the information product model, accounting can be carried out according to the costs-by-cause principle. With this user-oriented infrastructure-performance accounting, an approach is presented for solving the IT infrastructure accounting problem.

### Evaluation

Klesse's method provides an allocation of information products within a DWH CC. Therefore, it appears quite useful in realizing fairer allocation for this partial BI architecture component which is in shared use. By considering the resource consumption for every defined information product, derived costs would be charged to beneficiaries in an equal way. Because of the theoretical nature of this approach—it has not yet been tested in practice—it is not clear how helpful this method would be in coming closer to a holistic cost and performance allocation of BI. Because of the detailed nature of this approach, we think it could be difficult to realize an economical, understandable, and maintainable cost allocation within a DWH CC. Aggravated by existing dependencies within the defined information product infrastructure, we suppose that the complexity of this approach would be enormous.

### **3.6 Cost accounting for shared IT Infrastructures (Brandl, Bichler, & Ströbel, 2007)**

This paper [17] introduces a method aimed at determining usage-based cost allocation keys for customer-oriented services based on their estimated resource consumption. The authors point out that an allocation of IT infrastructure costs to application owners would increase cost transparency. This can be achieved if every user request is tracked across systems by a unique user ID, resulting in a detailed monitoring and metering of the user's resource consumption. Due to the considerable effort required to do this, it is not practical. To reduce the efforts involved in detailed monitoring, the user's IT resource consumption can be estimated using the following approach, which takes the three following requirements into consideration:

- The estimator should be unbiased.
- The estimate should be independent of the IT infrastructure.
- The estimate should create only limited extra work in terms of economic implementation.

The idea behind this task is to create so-called resource profiles which specify an invocation of a service. The allocation method is then described by invocations to a service within a given accounting period. Brandl et al. describe a service as being, for example, access to an information system such as "browse catalog" or "check plant status." A service can also be defined as an application that contains these individual use cases. A resource profile is calculated by carrying out a certain number of load tests (10 to 100) under consideration of, for example, five different user roles (low to heavy user).

Hence it is possible to derive an average CPU time, storage I/O and network traffic for a single service.

### Evaluation

The resulting resource profiles measure the average behavior of different user types for a given IT service. The resource consumption measurement is therefore made on a more abstract level to handle the problem of an expensive hard monitoring of every service invocation. Hence these resource profiles could be useful as cost allocation keys for cost allocation in shared IT infrastructures. In terms of the requirements in Section 2, this approach comes closer to a fair allocation of BI costs, but it is not certain that all beneficiaries are treated equally. A user could make extra use of a service such as a dynamic BI report by applying filter settings in such a way that a defined resource profile is no longer applicable. Depending on a company's current situation, BI artifacts might be needed more in economically difficult times than in prosperous times. Therefore, it is necessary to continuously recalculate resource profiles. This, in turn, leads to increased expenses, making the resulting IT or BI cost allocation economically unfeasible. In addition, BI artifact consumption is difficult to forecast, because the demand for decisions is not subject to regularity in normal cases.

### **3.7 From strategy to business intelligence competency center (Gansor, Totok, & Stock, 2010)**

The authors of this publication describe the development and operation of a BI competency center (BICC) by considering a wide range of topics [4]: from the creation of a BI strategy to the definition and arrangement to the operation of a BICC. The controlling of a BICC is presented under the topic of operation. One essential point must be made clearly evident for beneficiaries: exactly which BI services are provided, whether once or on a regular basis, at what level of quality, and at what cost. Service level agreements are mentioned as prior conditions for the charging of costs and for cost-oriented management. Furthermore, BI services must be specified in a catalog. The authors thus emphasize the significant difference between IT and BI: While BI focuses on delivering information for the decision-making process at a more managerial level, the IT department provides information technology. It is therefore difficult to determine the cost of a specific piece of information. A method by Klesse (Section 3.5) is briefly described as a possible approach, with the realization of an internal cost allocation described as a difficult task. The following three approaches involve the establishment of an internal cost allocation carried out in a BICC that is organized as a cost center:

- Since a BICC acts across departments within a company, the allocation of BI costs could be realized by charging overhead costs. It remains unclear how to best derive a suitable distribution key. This flat rate approach is criticized because of the possibility of billing only low costs to very active customers. Furthermore, because of missing assessments for individual BI services, an external comparison is not given. In addition, it is mentioned that a flat rate allocation does not contribute to beneficiaries' cost awareness. Ad-hoc reports, then, which may be relatively easy for beneficiaries to create, can be transferred to the BICC.
- By using usage-dependent allocation, individually requested services in a BICC are charged in detail. Intensive users are thereby charged more than occasional users. As a basis for allocation, the time spent creating a BI service or resource-dependent metrics such as storage volume or quantity of reports could be used. The main challenge of this approach lies in the automated charging of the determined measurements. Furthermore, there is a conflict of objective, as a cost center manager could be encouraged to reduce costs relating to the optimization of premiums and therefore individual BI demands might not be implemented by a BICC but through an island solution.



- The last BI cost allocation approach involves the expected usage and is realized by considering the BI project portfolio. This requires departments that plan a project to pay the resulting costs of the BICC. The above-mentioned conflict of objective could therefore be resolved by including the planned charging of BI costs within the department's targeted cost planning.

### Evaluation

The first two approaches, while seemingly obvious, can be seen as contrary (flat rate vs. detailed). Since charging by using overhead costs is not carried out for single BI services, a fair allocation of BI costs, in terms of the requirements in Section 2, cannot occur. The usage-dependent allocation proves worthwhile since its focus is on fair allocation. Care should be taken to ensure that such an allocation of BI costs does not require an inappropriate amount of effort (economically justifiable execution). In addition, the beneficiaries must also be taken into consideration during the development of such cost allocation as the client relationship in the follow-up phase is an important element. Furthermore, an allocation based on expected usage is difficult to realize due to the very dynamic and short life-span of a BI project portfolio (depending on the organization). The beneficiaries, then, could be charged with costs during the planning phase, only to have the corresponding project canceled at a later date for some reason. To summarize, these approaches provide a very general description of how to carry out BI cost and performance allocation. A concrete design, however, cannot be detailed at this point.

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## **4 Summary of the evaluation concepts**

The approaches screened in this paper are intended to provide an overview of appropriate approaches to the allocation of BI costs and performance. A comparison between BI and IT has shown that these

two areas differ significantly and therefore require different costing approaches. With the help of fundamental requirements for an internal cost allocation system, in addition to our evaluation, readers should be able to form their own opinions on the subject. It is worth noting that none of the approaches introduced here refers to BI accounting in a holistic way. There are, however, general and detailed accounting ideas which may be adaptable to individual components of BI architecture. The approaches presented by Klesse [11] or Brandl [17] attempt to solve a portion of the entire problematic situation, but because of their detailed methods, we assume this would bring about very high expenses in practice. Klesse focuses on information product accounting within a DWH CC, whereas Brandl provides a method for distinguishing allocation keys by so-called resource profiles. The specification of both methods, which could lead to a fair allocation of BI costs and performance, results in an uneconomical overall BI cost and performance allocation system. Standard publications regarding IT controlling, such as ITIL [1] or Hamel et al. [13], provide an overview of IT controlling, but the description of individual concepts remains very general. In summary, many questions remain with regard to BI cost and performance accounting. To add to this, there are still issues concerning IT controlling, particularly the allocation of IT costs, that remain unresolved [18].

## 5 Conclusion

This paper has addressed a variety of costing approaches useful for specific parts of a BI landscape. A comparison between BI and IT has shown that a dedicated costing for BI is necessary. Along with specific methods, a general description has been provided as to how BI costing could be realized. However, this is a work in progress and will be extended by including additional literature from Section 3.8. The continued goal is to research an appropriate holistic approach to the allocation of BI costs and performance. This literature review could be used as a starting point for the development of a holistic approach to BI cost and performance allocation. A future method should take note that the rising costs related to BI cost and performance allocation should not outweigh the resulting benefits. Accordingly, an area of conflict exists between the fair allocation of costs by some of the approaches presented here and an economical execution of a cost and performance allocation.

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